

Docket No.: 0234-0510PUS1
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Kazuhiro MURATA et al.

Application No.: 10/566,476

Confirmation No.: 5098

Filed: January 31, 2006

Art Unit: 1791

For: METHOD OF PRODUCING A THREE-
DIMENSIONAL STRUCTURE AND FINE
THREE-DIMENSIONAL STRUCTURE

Examiner: SULTANA, NAHIDA

DECLARATION UNDER 37 CFR 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Mr. Kazuhiro Murata, declare the following.

I am one of the inventors of the present invention described in the above-described application. I am fully knowledgeable of the disclosure of the above-identified application and the field of art of the present invention. I have read and understand the Office Action dated July 20, 2010 and the references cited therein to Danforth et al. (US patent No. 5,997,795), Sachs et al. (US patent No. 5,807,437), Gratson et al. (US publication 2006/0235105), Uchiyama et al. (US patent No. 4,897,667), Hayes (US patent No. 6,114,187), Hertz (US patent No. 3,916,421)

I have been given the following awards based on the present invention as follows:

(1) Nano Tech Award (Grand Prix), micro-fabrication category, nano tech 2002 (International Nanotechnology Exhibition & Conference), Tokyo, Japan, March 8, 2002.

(2) President's Award for Earnest Research, National Institute of Advanced Industrial Science and Technology (AIST), Tokyo, Japan, April 1, 2004.

(3) Chairman's Award, Nippon Keidanren (Japanese Business Federation), conference for the promotion of collaboration among business, academia, and government, Tokyo, Japan, June 20, 2004.

(4) Best Paper Award, International Conference on Electronics Packaging (ICEP) 2005, April 19, 2006.

I have also been invited to give presentations with regard to the present invention at the following conferences:

(1) July 23, 2003, International Conference on MEMS, NANO, and Smart Systems, Banff, Canada "Super fine ink-jet printing for nanotechnology" Kazuhiro Murata

(2) May 13, 2004, Design, Test, Integration and Packaging of MEMS/MOEMS (DTIP2004), Montreux Switzerland "Super-fine inkjet printing -toward the minimal manufacturing system- Kazuhiro Murata et al.

(3) October 27, 2004, Microprocesses and Nanotechnology 2004, Tokyo Japan "Super fine wiring by inkjet printing" Kazuhiro Murata

(4) June 13, 2005, ACS/MRS//IEEE CPMT Organic Microelectronics Workshop Newport, Rhode Island, USA "Direct micro wiring by super fine ink-jet" Kazuhiro Murata

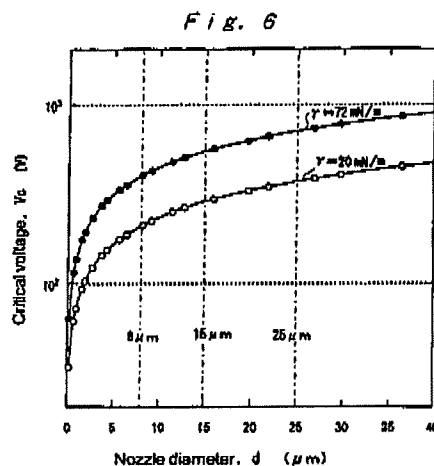
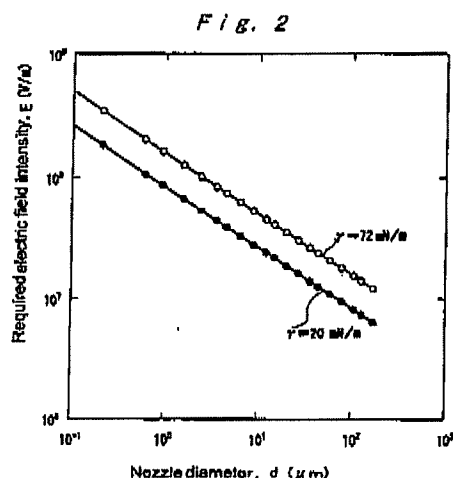
(5) April 15, 2005, International Conference on Electronics Packaging ICEP2005, Tokyo, Japan "Fine-pitch micro-bumps and Micro-wires Printed by Super Inkjet Technology", Kazuhiro Murata

(6) 21 September 2007, 23rd International Conference on Digital Printing Technologies (NIP23), Alaska, USA "Micron order patterning by a novel inkjet technology, SIJ", Kazuhiro Murata et al.

(7) January 24, 2008, International TFT Conference, Seoul, Korea "Micron order inkjet patterning for printable electronics" Kazuhiro Murata et al.

It is my opinion that the presently claimed ultrafine fluid jet apparatus is not made obvious by the cited references. My opinion is based on the following considerations.

1. I developed ultrafine fluid jet apparatus, as cutting edge technology enabling to deposit super fine droplets rather smaller than the conventional devices. This invention has already been filed in USPTO and granted as a patent (US 7,434,912) (WO03/070381, see the present specification p.25 ll.10-11). According to this technology, relieved from the restriction of the conventional technical principle, the smaller nozzle can realize the smaller voltage droplet ejection. That is, practical droplet ejection of an ultra fine nozzle, e.g., having a sub-micrometer or nanometer order inner diameter, for the first time, has been realized based on the unique mechanism of the invention. This phenomenon is proven based on an embodiment in the patent specification of US 7,434,912 as shown in Fig. 6 (working example) compared to Fig. 2 (comparison example) of the conventional art. In the present invention, the nozzle diameter is particularly limited in the range of 0.01 – 8 μm in order to effectively utilize the size effect of the above described mechanism as to ejecting ultrafine fluid jet.



2. This technology has continually been studied by me. Then, I finally encountered the new fact that fine droplets fly in line along with the electric line of force energized by the focused

electric field at the tip of the nozzle, and they uprightly grow into a pillar shape. Even in a sub-micrometer or nanometer size, such pillar can grow toward the nozzle end without falling down. That is, the droplet is continuously attracted to the top of a solidified substance. Such unique effect and phenomenon involved in the present invention had neither been clarified nor written in the patent application that issued as US 7,434,912, and they are for the first time revealed in the present specification as follows (see the present specification page 11, line 17 to page 12, line 17):

In the method of producing a three-dimensional structure according to the present invention, ultra-fine droplets are discharged using ultra-fine inkjet. The ultra-fine droplets are evaporated extremely quickly by the influence of surface tension and the magnitude of a specific surface area. Hence, by controlling the drying and solidifying of the droplet (in the present invention, unless otherwise specified, the terms of drying and solidifying means that the liquid drops are evaporated and dried, thereby being increased in viscosity at least to a level such that the droplets can be stacked up), impact energy, focusing of electric field, and the like at appropriate levels, it is possible to form a three-dimensional structure having height. Hereinafter, these points will be described in more detail.

(Accurate Landing of Droplet with Focusing Electric Field)

In the method of producing a three-dimensional structure according to the present invention, stress toward the tip of a needle-shaped fluid discharging body (hereinafter also referred to as "nozzle") is continuously applied to the top of a structure formed by droplets that have been previously landed to a substrate (hereinafter also referred to as "previously landed droplets") and that have been solidified, in virtue of an effect of an electric field applied to an ultra-fine inkjet. Accordingly, once a structure starts growing, an electric field to be described later in FIG. 5 can be focused on the top of the structure. For this reason, an ejected droplet can be reliably and accurately landed on the top of the structure formed by the droplets having attached in advance.

Furthermore, the structure can be grown in the direction of the nozzle while it is always pulled by the above-mentioned effect produced by the electric field, and hence even if the structure has a high aspect ratio the structure can be formed without falling. These effects can efficiently promote the growth of a three-dimensional structure.

3. The above explained phenomena involved in the ultrafine fluid jet apparatus were utterly unexpected from the cited art references for the person having ordinary skill in the art at the time that the present invention was made.

Thus, the subject matter of the present invention, which can achieve remarkable result based on the unique technical principle, is neither taught nor suggested in the cited art references.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.


Signature

October 15, 2010
Date

Kazuhiro Murata